DEPARTMENT OF THE INTERIOR
U.S.GEOLOGICAL SURVEY

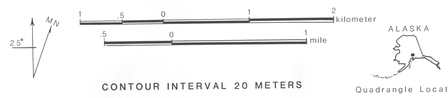
PREPARED IN COOPERATION WITH
ALASKA DIVISION OF GEOLOGICAL AND GEOPHYSICAL SURVEYS

OPEN-FILE REPORT 88-418
SHEET 1 OF 1

SCALE 1:25,000

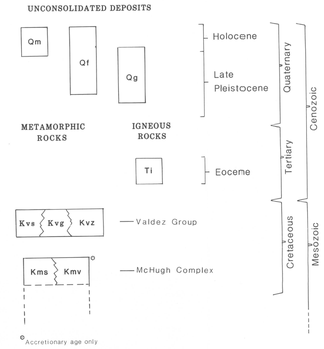
CONTOUR INTERVAL 20 METERS

BASE MAP PUBLISHED BY THE GEOLOGICAL SURVEY, 1979, FROM AERIAL PHOTOGRAPHY TAKEN IN 1972. CONTROL BY USGS AND NOS/NOAA. NATIONAL GEODETIC VERTICAL DATUM OF 1929. 2000-m UTM GRID ZONE 6, 1927 NORTH AMERICAN DATUM. ALL CONTOURS AND ELEVATIONS ARE IN METERS.



GEOLOGY BY R.G.UPDIKE AND C.A.ULERY, 1983-86, ASSISTED BY K.KRAUSE, J.REEDER, R.ALLEY, AND M.PRITCHARD UNDER THE AUSPICES OF THE U.S.G.S. EARTHQUAKE HAZARDS REDUCTION PROGRAM. THE TECHNICAL ASSISTANCE OF A.F.ESPINOSA, L.A.YEMLE, AND H.R.SCHMOLL AND THE TECHNICAL REVIEWS OF G.R.WINKLER AND S.W.NELSON ARE APPRECIATED. THE PREVIOUS MAPPING OF CLARK AND DARTSCH (1971) WAS UTILIZED IN THE FIELD.

CORRELATION OF MAP UNITS



Radiometric Age Dates

STA.	METHOD	DESCRIPTION	AGE	NOTE
PC-1	C-14	Basal peat in pond, rock glacier deposit, cirque floor, Peters Creek Valley	4590 ± 175 ybp	1
CKA-1	K/Ar	Felsite sill intruded into Valdez Group, Eagle River Valley wall	50.2 ± 2.5 Ma	2
CKA-2	K/Ar	Felsite dike intruded into Valdez Group, Peters Creek Valley tributary	50.0 ± 2.6 Ma	3

Notes: 1] Geochron Laboratories, GX-11856, 3/28/86, C-13 corrected.

2] Teledyne Isotopes Laboratories, KAB5-07655, 9/25/86, whole rock analysis, % Ar-40 = 50.6, 53.0; % K = 0.51, 0.51.

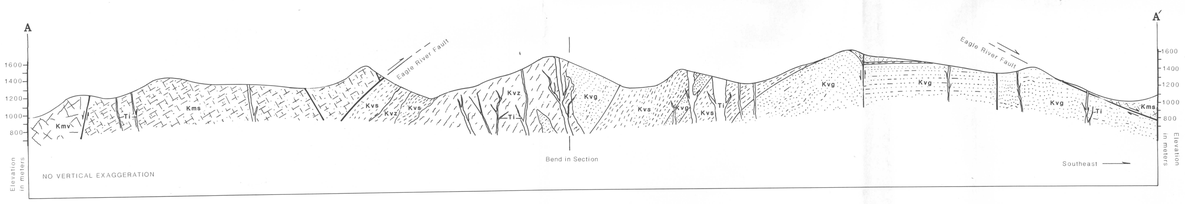
3] Teledyne Isotopes Laboratories, KAB5-07656, 9/25/86, whole rock analysis, % Ar-40 = 37.9, 46.2; % K = 0.35, 0.35.

Trace Element Analyses, X-ray Fluorescence, in ppm

STA.	ROCK TYPE	Cr	Rb	Sr	Y	Zr	Nb	Ba
C4	Valdez graywacke	100	60	160	10	140	10	550
Y5	Valdez graywacke	80	70	150	30	120	10	640
Y7A	Valdez graywacke	100	40	110	10	150	10	410
Y7B	Valdez graywacke	80	70	150	20	170	20	720
Y28	Valdez graywacke	90	30	140	20	170	20	440
Y13	Valdez graywacke	100	40	190	10	180	20	750
Y14	Valdez gray.-altered	110	120	100	20	190	10	1060
Y50	Valdez gray.-altered	120	100	210	20	160	20	1090
Y51	Valdez argillite alter.	100	50	140	10	140	20	70
Y52	Valdez argillite alter.	60	40	300	10	70	10	590
Y31	Valdez gray. at felsite	30	40	520	20	90	20	430
Y38	Valdez phyl.at E.R.fault	10	20	1240	10	10	10	140
C8	McHugh graywacke	50	50	720	20	80	20	590
C11	McHugh graywacke	70	50	730	30	80	30	460
Y35	McHugh argillite	50	20	250	20	80	10	400
E20	McHugh metavolcanic	40	50	270	30	100	10	940
E21	McHugh metavolcanic	50	50	190	40	150	10	510
Y36	McHugh metavolcanic	50	50	670	10	80	10	680
Y55	McHugh metavolcanic	60	40	590	10	90	20	880
Y32	Felsite dike	40	40	570	10	100	20	270
Y50	Felsite dike	30	50	810	10	80	10	540
Y9	Felsite dike (center)	40	10	410	10	90	10	500
Y10	Felsite dike (base)	40	40	570	10	80	10	490
Y12	Felsite dike	40	30	470	10	110	10	510

MAP SYMBOLS

- GEOLOGIC UNIT CONTACT, APPROXIMATELY LOCATED
- HIGH ANGLE FAULT: DASHED WHERE APPROXIMATE, DOTTED WHERE CONCEALED, U=UPTHROWN, D=DOWNTHROWN, ARROWS SHOW RELATIVE MOVEMENT.
- THRUST FAULT: SAWTEETH ON UPPER PLATE.
- ANTIFORMS SUPERIMPOSED ON ISOCLINAL SYNSTRUCTURE, AXIAL ARROW IN DIRECTION OF PLUNGE.
- STRIKE AND DIP OF BEDS
- VERTICALLY DIPPING BEDS
- RADIOMETRIC AGE DATE LOCALITY
- GEOCHEMICAL ANALYSES LOCALITY



BEDROCK GEOLOGY OF THE ANCHORAGE (B-7SE) QUADRANGLE, ALASKA

BY

R.G. UPDIKE AND C.A. ULERY

1988

DESCRIPTION OF MAP UNITS

UNCONSOLIDATED DEPOSITS

Qm — MASS MOVEMENT DEPOSITS (HOLOCENE) -- Gray and brown; silt, sand, gravel, and massive rock. Weakly stratified to non-stratified. Resultant from various gravitational-related processes including rock slide, soil slide, colluviation, solifluction, and rock fall (talus). Commonly actively forming or moving.

Qf — FLUVIAL DEPOSITS (PLEISTOCENE TO HOLOCENE) -- Gray to tan; silt, sand, and gravel, poorly to well-stratified. Loose to moderately packed fabric, may be saturated with water near the surface. Includes floodplains, alluvial terraces and fans, and glacial outwash plains and kame terraces. Commonly being actively deposited and eroded.

Qg — GLACIAL AND PERIGLACIAL DEPOSITS (PLEISTOCENE TO HOLOCENE) -- Gray, tan, and buff-orange; clay, silt, sand, and gravel. Generally non-stratified; locally discontinuously stratified. Loose to very densely-packed fabric, dry to saturated with water near the surface. Locally, unstable where saturated on steep slopes. Resultant from ice-marginal deposition (till, ice-contact deposits) or periglacial deposition (rock glacier, protalus lobe or rampart). Carbon-14 date suggests that this unit, in cirque valleys, is Holocene age.

METAMORPHIC ROCKS

Kvs — VALDEZ GROUP (LATE CRETACEOUS) -- Flysch sub-terrane of the Chugach Terrane (Jones and Clark, 1973; Tysdal and Plafker, 1978), comprised chiefly of clastic sedimentary rocks that have undergone extensive diagenesis and low-grade metamorphism (zeolite to chlorite zone-greenschist facies). Coarse-grained metasandstone (metagraywacke) and fine-grained argillite-phyllite constituents are rhythmically interbedded but typically one of these end members predominates, and can be differentiated in mapping. Sedimentary structures (bedding planes, graded bedding, cross-bedding, convolute laminae, and channel-fill structures) are preserved. Composition of clasts is predominantly lithic fragments and feldspar with lesser amounts of quartzose fragments and mafic minerals (see ternary diagram) and is classed a feldspathic litharenite. The group is deformed both by moderate flooding and brittle shear, including dip-slip and strike-slip faulting. Although quartz veins are found abundantly in the Valdez Group elsewhere (e.g., Winkler and others, 1981), in this quadrangle only minor veinlets are generally observed. In the central part of the quadrangle the group has been extensively intruded by felsite dikes and sills subparallel to fault and joint trends. A Late Cretaceous age is based upon fossil records reported elsewhere (Jones and Clark, 1972; Tysdal and Plafker, 1978).

Kvs — FINE-GRAINED METASEDIMENTARY ROCKS -- Medium gray, dark gray, and black argillite and phyllite (metamorphic products of a siltstone-mudstone sequence). Thin planar bedding, even or splintery rock cleavage, wavy foliation, and distinct acute-angle joints result in rubble exposures. Ductile deformation of matrix (micas, chlorite, calcite) around more rigid components (feldspar, lithic clasts, quartz).

Kvg — MEDIUM- TO COARSE-GRAINED METASEDIMENTARY ROCKS -- Medium gray, greenish gray, and dark gray metasandstone (metagraywacke) and metaconglomerate (metamorphic products of original feldspathic litharenite). Thin to massive bedding, blocky joint patterns and weak foliation. Framework clasts are moderately to well-sorted, subangular to angular, and chiefly include lithic fragments (volcanic rock, schist), plagioclase, chert, quartz, and micas. Authigenic minerals include pyrite, microcrystalline silica, calcite, clay, albite, and epidote.

Kvz — ALTERED METASEDIMENTARY ROCKS -- Brick red to yellow-orange and dark brown on joint surfaces, dark gray with orange stains on fresh faces; metasandstone and argillite hydrothermally altered within an irregular zone in center of quadrangle. Secondary replacement of clasts, solution along microfractures, vacuolized quartz and calcite, metallic sulphide precipitates. Platy cleavage and flaggy jointing.

McHUGH COMPLEX (CRETACEOUS) -- Melange sub-terrane of the Chugach Terrane (Clark, 1973; Plafker and others, 1985) comprised chiefly of clastic sedimentary and volcanic rocks which have undergone metamorphism to prehnite-pumpellyite facies. Age here used is an accretionary age; other fossils indicate protolith ages from Mississippian to Cretaceous (Nelson and others, 1986). The primary rock types are metasandstone (metagraywacke) and greenstone in nearly equal proportions with substantially lesser amounts of metaconglomerate, argillite, and metachert. Although rock types are intermixed due to both original deposition and subsequent structural disturbance, dominant lithologic units can be mapped. Both sedimentary and volcanic primary structures are preserved, but metamorphic stresses have caused primary features to be obscured. Brittle deformation ranging from microshears in hand specimens to megashears across ridge crests is ubiquitous, indicative of a melange-type deformation. Major high-angle block and strike-slip faulting are present throughout the complex and felsite dikes locally have intruded along these faults and the pervasive blocky joint systems. The complex spatially overlies the Valdez Group along the Eagle River thrust fault; however, the fault contact is locally difficult to pinpoint.

Kms — METASEDIMENTARY ROCKS -- Dark green on weathered surfaces; gray to gray-green on fresh faces. Chiefly metagraywacke but locally metaconglomerate, phyllite, and argillite. Secondary quartz and calcite veins penetrate the rock regardless of structure. Clasts and groundmass commonly show micro-shears. Altered plagioclase and lithic clasts are most abundant, although many clasts are altered to microcrystalline quartz, chlorite, epidote, and clay minerals. Prehnite and pumpellyite are common random replacement minerals indicating a sub-greenschist facies of metamorphism. Quartz-rich argillite occurs as thin wavy-foliated beds and is usually highly sheared. Phyllite is dark gray, chloritic, and occurs as discontinuous lenses. Metavolcanic layers are a secondary component of this unit.

Kmv — METAVOLCANIC ROCKS -- Dark green, reddish green, or orange-buff on weathered surfaces; gray, green, and blue-green on fresh faces. Chiefly andesitic flow and metatuff altered to greenstone. Secondary quartz and calcite veins are abundant. Plagioclase and pyroxene are the chief indentifiable minerals although often deeply altered. Prehnite and pumpellyite are common metamorphic minerals. Banded metachert and argillite are also typical though localized; argillite is generally associated with shear zones. Metagraywacke occurs as secondary in abundance to the greenstone. This unit is intensely faulted and rotated, typical of melange.

IGNEOUS ROCKS

Ti — FELSITE INTRUSIONS -- Buff on weathered surfaces; light gray, rose, or greenish-gray on fresh faces. Tonalite to trondhjemite occurring as dikes and sills varying from less than 1 m to several meters thick. Intruded along faults, joints, bedding in host rock. Most abundant in the Valdez Group; also present in McHugh Complex. Oligoclase, partially resorbed quartz, and sparse hornblende and biotite phenocrysts occur in an aphanitic (sometimes trachytic) groundmass of quartz, plagioclase, and mafic minerals. The country rock locally exhibits hydrothermal alteration and angular fragments thereof occur as inclusions in the felsite. Both K-Ar dates support an Eocene age. The intrusions post-date all faults intersected.

SUMMARY OF GEOLOGY

The Anchorage B-7SE quadrangle consists predominantly of two fault-bounded tectonostratigraphic sub-terranes of the Chugach Terrane, the Valdez Group (flysch sequence) and the McHugh Complex (oceanic volcano-sedimentary sequence), which are believed to have been accreted onto southern Alaska during Cretaceous time (Plafker and others, 1976, 1977). The structural 'grain' of these units is approximately north-northeast to south-southwest, a result primarily of the northwest vector of accretionary stresses and the resultant underthrusting of the Valdez Group. The modern-day exposure of the Valdez Group in this quadrangle results from an erosional window through the overlying McHugh Complex and Eagle River fault, into the underthrust sheet. Protolith ages at the type locality of the McHugh Complex (35 km south) range from Late Mississippian-Early Pennsylvanian to Early Cretaceous (Nelson and others, 1986) and an accretionary age of Middle Cretaceous is proposed by Nelson and others (1987). This accretion was accompanied by substantial deformation resulting in pervasive shearing and juxtaposing of varied rock assemblages, locally being a melange (Clark, 1972, 1973). High-angle faults, with both dip-slip and strike-slip components, and limited to less than a few km in mappable length were associated with this period of deformation.

The fossil ages for the Valdez Group are restricted to Late Cretaceous (Jones and Clark, 1973; Tysdal and Plafker, 1978). The accretion to the Valdez Group occurred during Late Cretaceous time (Plafker and others, 1977; Zuffa and others, 1985; Winkler and others, 1981) resulting in a strongly-deformed, northeast-dipping stack of isoclinal units. Antiforms and localized high-angle faults oblique to the direction of principal stresses reflect physical adjustments in the underthrust package. No evidence was found to suggest that structures within the Valdez Group were carried through the Eagle River fault into the McHugh Complex. However, the obvious northwest trend of axes of the major stream valleys may reflect the hidden occurence of through-cutting faults.

The plate-convergence metamorphism of the Valdez (zeolite-greenschist) and McHugh (prehnite-pumpellyite) rocks is probably equivalent to the Early Tertiary regional metamorphism of Plafker and others (1985). This metamorphism was probably synchronous with the on-going accretionary process.

Numerous mid-Tertiary (Eocene) age felsite dikes (and locally, sills) intrude both the Valdez and McHugh rocks, though the dikes are far more prolific in the Valdez. The dikes typically cross-cut bedding and foliation trends, and are not identifiable with specific joint sets (which are routinely random, see stereonet plot). The northwest trend of the dikes is approximately parallel to the northwest-oriented faults, suggesting that the faults may have been intrusion pathways. However, very often the dikes have no association with observable faults. In no instance was a dike found to be offset by a fault. Tabular felsite intrusions were found on, and concordant with, the Eagle River fault, with no indication of offset or shear. With the exception of textural variations reflecting differing cooling rates, the felsites chemically and mineralogically are uniform across the map and we have no reason to doubt that two K-Ar dates represent the time period when all dikes were emplaced, i.e. 50 million years. Therefore, we are led to conclude that no faults crossed by the intrusions in this quadrangle have been active since Eocene time. We believe that the difference in abundance of felsite intrusions between Valdez and McHugh results from (1) the facility of the less-indurated Valdez to accomodate intrusion, and (2) a closer proximity of the underthrust Valdez Group to a shallow magma source body. The density of dikes near the center of the map, combined with the irregular zone of hydrothermally-altered Valdez rocks (Kvz) suggests to us the likely presence of a tertiary stock beneath the center of the quadrangle.

During the middle to late Quaternary the area was subjected to multiple glaciations with the source areas for most of these glaciers being to the southeast. Tributary and hanging glaciers occupied several of the larger basins along both the Eagle River and Peters Creek Valleys. Extensive periglacial activity produced large lobate deposits in some of the more protected north-facing basins in Peters Creek Valley. Within the boundaries of the map no evidence was found in Quaternary deposits to suggest Holocene fault displacement.

REFERENCES CITED

Clark, S.H.B., 1972, Reconnaissance bedrock geologic map of the Chugach Mountains near Anchorage, Alaska: U.S.Geological Survey Miscellaneous Field Studies MF-350, 1 sheet scale 1:250,000.

_____ 1973, The McHugh Complex of south-central Alaska: U.S.Geological Survey Bulletin 1372-D, p. D1-D11.

Clark, S.H.B., and Bartsch, S.K., 1971, Reconnaissance geologic map and geochemical analyses of stream sediment and rock samples of the Anchorage B-7 Quadrangle, Alaska: U.S. Geological Survey Open-file Report 1971, 16 p., 1 sheet, scale 1:63,360.

Jones, D.L., and Clark, S.H.B., 1973, Upper Cretaceous (Maestrichtian) fossils from the Kenai-Chugach Mountains, Kodiak and Shumagin Islands, southern Alaska: Journal of Research, U.S.Geological Survey, v. 1, no. 2, p. 125-136.

Nelson, S.W., Blome, C.D., Harris, A.G., Ford, K.M., and Wilson, F.H., 1986, Late Paleozoic and Early Jurassic fossil ages from the McHugh Complex: U.S.Geological Survey Circular 978, p. 80-84.

Nelson, S.W., Blome, C.D., and Karl, S.M., 1987, Late Triassic and Early Cretaceous fossil ages from the McHugh Complex, southern Alaska: U.S.Geological Survey Circular 998, p. 96-98.

Plafker, George, Jones, D.L., Hudson, Travis, and Berg, H.C., 1976, The Border Ranges fault system in the Saint Elias Mountains and the Alexander Archipelago: U.S.Geological Survey Circular 733, p.14-16.

Plafker, George, Jones, D.L., and Pessagno, E.A., Jr., 1977, A Cretaceous accretionary flysch and melange terrane along the Gulf of Alaska margin: U.S.Geological Survey Circular 751-B, p. B41-B43.

Plafker George, Nokleberg, W.J., and Lull, J.S., 1985, Summary of the 1984 TACT geologic studies in the northern Chugach Mountains and southern Copper River Basin: U.S.Geological Survey Circular 967, p. 76-79.

Tysdal, R.G., and Plafker, George, 1978, Age and continuity of the Valdez Group, southern Alaska: U.S.Geological Survey Bulletin 1457-A, p. A120-A132.

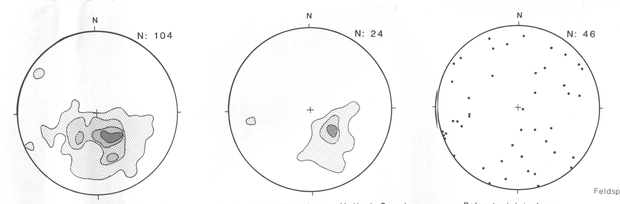
Winkler, G.R., Silberman, M.L., Grantz, Arthur, Miller, R.J., and Mackevett, E.M., Jr., 1981, Geologic map and summary geochronology of the Valdez Quadrangle, southern Alaska: U.S. Geological Survey Open-file Report 80-892A, 2 sheets, scale 1:250,000.

Zuffa, G.G., Nilsen, T.H., and Winkler, G.R., 1985, Rock fragment petrography of the Upper Cretaceous Chugach terrane, southern Alaska: U.S.Geological Survey Open-file 85-713, 28 p.

Major Oxide Analyses, X-ray Fluorescence, in percent

STA.	ROCK TYPE	SiO_2	Al_2O_3	CaO	MgO	Na_2O	K_2O	FeO	MnO	TiO_2	P_2O_5	LOI	Total
C4	Valdez graywacke	71.7	12.7	0.50	1.80	3.88	1.05	4.65	0.06	0.66	0.17	2.47	99.8
Y5	Valdez graywacke	70.8	13.7	0.48	1.59	3.23	1.49	5.08	0.06	0.66	0.15	2.54	99.9
Y7A	Valdez graywacke	72.6	11.5	0.91	1.59	3.29	0.94	4.97	0.06	0.69	0.17	2.70	99.5
Y7B	Valdez graywacke	69.6	14.9	0.23	1.65	3.59	1.76	4.55	0.05	0.69	0.14	2.70	100.0
Y28	Valdez graywacke	70.7	12.8	1.05	1.58	3.03	1.25	5.54	0.07	0.68	0.15	2.85	99.8
Y13	Valdez graywacke	72.3	13.3	1.27	1.42	3.27	1.61	3.85	0.07	0.74	0.15	1.85	100.0
Y14	Valdez gray. altered	61.9	18.1	0.58	2.18	1.80	3.34	7.65	0.10	0.95	0.21	3.70	99.9
Y50	Valdez gray. altered	60.2	18.1	1.78	2.70	2.58	2.95	7.36	0.17	0.89	0.24	2.93	99.9
Y51	Valdez argillite alter.	67.4	12.8	0.65	2.59	0.74	1.14	8.18	0.15	0.66	0.16	5.16	99.8
Y52	Valdez argillite alter.	71.0	14.0	0.59	1.53	5.04	0.58	4.47	0.08	0.53	0.11	1.93	100.0
Y31	Valdez gray.at felsite	67.2	16.7	3.51	1.84	4.88	0.92	2.82	0.05	0.36	0.11	1.47	100.0
Y38	Valdez phyl.at E.R.fault	45.7	4.52	24.80	1.03	0.62	0.47	3.20	0.66	0.18	0.08	20.50	100.0
C8	McHugh graywacke	55.9	17.4	4.63	5.01	3.94	1.75	7.04	0.15	1.02	0.25	4.31	99.6
C11	McHugh graywacke	56.6	16.0	6.24	5.37	3.56	1.12	8.04	0.18	1.02	0.21	3.08	99.6
Y35	McHugh argillite	60.0	15.3	5.70	2.81	3.34	0.78	6.77	0.13	0.72	0.12	4.08	99.8
E20	McHugh metavolcanic	66.1	14.9	2.73	2.03	4.17	2.08	4.90	0.10	0.53	0.10	2.25	100.0
E21	McHugh metavolcanic	63.2	14.1	6.16	2.27	2.85	10.60	5.42	0.12	0.62	0.13	3.00	100.0
Y36	McHugh metavolcanic	57.0	16.7	5.07	3.55	3.69	1.90	7.68	0.14	0.87	0.25	3.16	100.0
Y55	McHugh metavolcanic	60.1	17.5	2.95	2.64	5.25	1.89	5.61	0.12	0.60	0.18	2.85	99.9
Y32	Felsite dike	69.6	16.0	3.49	1.31	4.75	0.68	2.15	0.05	0.31	0.11	1.31	99.9
Y50	Felsite dike	69.9	15.3	2.71	0.93	5.12	0.56	2.74	0.09	0.31	0.10	1.93	99.8
Y9	Felsite dike (center)	70.0	16.1	3.66	0.95	5.39	0.64	1.75	0.04	0.30	0.10	1.00	99.8
Y10	Felsite dike (base)	66.8	17.7	2.51	1.73	5.56	0.99	2.72	0.05	0.56	0.09	2.31	100.0
Y12	Felsite dike	68.1	16.0	3.48	1.44	4.60	0.84	2.02	0.05	0.31	0.11	1.95	99.0

South-pole Schmidt Stereonet Plots

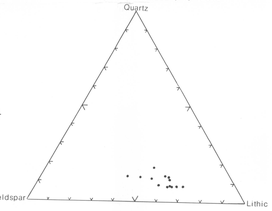


Poles to bedding planes, Valdez Group
Contours: 1%, 4%, 8%, 12%
per 1% area, max. 16%

Poles to bedding planes, McHugh Complex
Contours: 4%, 12%, 20%
per 1% area, max. 30%

Poles to joint planes, McHugh Complex

Clast composition, Valdez graywacke



This map was prepared under a grant from the U.S.Geological Survey and has not been reviewed for conformity with the USGS editorial standards and stratigraphic nomenclature. Opinions and conclusions expressed herein do not necessarily represent those of the USGS.